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169Tm NMR study of the high-Tc superconductor TmBa2Cu3O6.92

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Abstract

The ground state of Tm3+ ion (4t2,3H6) in a crystal electric field (CEF) of TmBaCuO is a singlet, separated from the lowest excited states by an energy gap of 100÷130 cm-1. The pulsed NMR of169Tm nuclei (spin I=1/2) in a magnetically-oriented TmBa2Cu3O6.92 power is studied at temperatures 1.5÷4.2 K. Two sorts of Tm nuclei are observed: rapidly relaxing Tm1 (≥80% of total amount, having relaxation times T1 (1)≈35 ms, T2 (1)=80÷250 μs) and slowly relaxing Tm2 nuclei (≦20%, T1 (2)=300÷1000 μs). The169Tm NMR spectra are described by the spin-Hamiltonian $\mathcal{H}1 = -\hbar\Sigma\gamma iHili$ (i = x,y,z), where |γx (1)/2π| = 5.3(1), |γy (1)/2π| = 6.6(1), |γx (2)/2π| = |γy (2)/2π| = 5.1(1), |γz (1)/2π| = |γz (2)/2π| = 2.3(1) kHz/Oe, and axes x, y, z coincide with the crystal axes a, b, c. The Tm1 and Tm2 nuclei are identified as those belonging to orthorhombic (CEF of D2h symmetry) and tetragonal (D4h) phases of the TmBaCuO compound, respectively. Two-exponential and nearly temperature-independent nuclear relaxation is observed at temperatures 1.5÷4.2 K. The smallest T2 (1)-values (≈80 μs) found for the orthorhombic (superconducting) phase in an external field H perpendicular to the crystal c-axis agree fairly well with those one could expect due to the dipole-dipole interaction of thulium nuclei. However, the slowing down of this rapid relaxation of the nuclear transverse magnetization in a field H{norm of matrix}c as well as the origin of unusually large T2 (2)-values remain unclear. © 1991 Springer.

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